Extra Copy

INSTRUCTION MANUAL

B+K PRECISION 1530

B-7

30 MHz, DELAYED SWEEP

Dual-Trace Oscilloscope

B+K PRECISION DYNASCAN CORPORATION

TEST INSTRUMENT SAFETY

WARNING

Normal use of test equipment exposes you to a certain amount of danger from electrical shock because testing must often be performed where exposed voltage is present. An electrical shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. Higher voltages pose an even greater threat because such voltage can more easily produce a lethal current. However, voltage as low as 35 volts dc or ac rms should be considered dangerous and hazardous since it can produce a lethal current under certain conditions. Your normal work habits should include all accepted practices that will prevent contact with exposed high voltage, and that will steer current away from your heart in case of accidental contact with a high voltage. You will significantly reduce the risk factor if you know and observe the following safety precautions:

1. Don't expose high voltage needlessly. Remove housings and covers only when necessary. Turn off equipment while making test connections in high-voltage circuits. Discharge high-voltage capacitors after removing power.
2. Use an insulated floor material or a large, insulated floor mat to stand on, and an insulated work surface on which to place equipment; and make certain such surfaces are not damp or wet. Where insulated floor surface is not available, wear heavy gloves.
3. Use the time-proven "one hand in the pocket" technique while handling an instrument probe. Be particularly careful to avoid contacting a nearby metal object that could provide a good ground return path.
4. Always use an isolation transformer to power transformerless "hot chassis" equipment, where one side of the ac power line is connected directly to the chassis. This includes most recent television sets and audio equipment. Without an isolation transformer, the chassis of such equipment may be floating at line voltage (120 VAC, 60 Hz in USA), depending upon which way the 2-wire ac power plug is inserted. Not only does this present a dangerous shock hazard if the chassis is touched, but damage to test instruments or the equipment under test may result from connecting the ground lead of some test instruments to a "hot" chassis. The ground lead of most oscilloscopes and most other test instruments with 3-wire power plugs is at earth ground. The B & K-PRECISION Model TR-110 Isolation Transformer is suitable for most applications.
5. On test instruments or any equipment with a 3-wire ac power plug, use only a 3-wire outlet. This is a safety feature to keep the housing or other exposed elements at earth ground.
6. If possible, familiarize yourself with the equipment being tested and the location of its high voltage points. However, remember that high voltage may appear at unexpected points in defective equipment.
7. Also remember that ac line voltage is present on some power input current points such as on-off switches, fuses, power transformers, etc., even when the equipment is turned off.
8. Never work alone. Someone should be nearby to render aid if necessary. Training on CPR (cardo-pulmonary resuscitation) first aid is highly recommended.

Instruction Manual

for

B+K PRECISION

Model 1530

30 MHz, Delayed Sweep

Dual-Trace Oscilloscope

This first edition instruction manual is a complete operator's manual only. We are currently preparing the second edition, which will have complete servicing information added. If you wish to receive a free copy of the complete manual as soon as it is available, fill out and return the tear-out postcard portion of the back cover.

B+K PRECISION DYNASCAN CORPORATION

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INTRODUCTION

The **B & K-Precision** Model 1530 Dual-Trace Oscilloscope is an accurate, professional instrument with its primary applications in engineering design labs, factory test and analysis centers, and well-equipped service shops or field service facilities. The delayed sweep feature of this oscilloscope permits close examination of a waveform; the variable delay permits any portion of the waveform to be examined. All waveforms up to 30 MHz can be expanded at least 5 times, and waveforms with repetition rates up to about 25 kHz can be expanded up to 1000 times. Such waveform displays are very useful, for example, for detecting high speed pulse aberrations, finding "glitches" in digital circuits, measuring rise time and decay time, and convenient in video systems for viewing any specific line or vertical field information such as VITS and VIR in the vertical blanking interval. The CRT has plenty of brightness to easily view waveforms at sweep expansion of 1000 times, where the sweep duty cycle drops to 0.1%. This oscilloscope permits you to display the channel A or channel B signal on the delayed sweep, as desired. For fast set-up an adjustment of delay time, the delayed portion of the trace may be intensified.

Performance features of the Model 1530 include high accuracy of both amplitude and time measurements (±3%), high sensitivity (5 mV/division), wide bandwidth (30 MHz), and fast rise time (11.7 ns). Most measurements can be made on an extra sensitive range of 2 mV/division. Even at 2 mV sensitivity, bandwidth is 20 MHz and rise time is 17.5 ns. Accuracy is enhanced by a rectangular CRT with internal graticule and post-deflection acceleration.

Naturally, the Model 1530 includes all the operational features you expect of a high quality, laboratory oscilloscope. Dual-trace operations permits two waveforms to be viewed simultaneously, or each may be viewed independently. An ADD mode allows both inputs to be summed and displayed as a single trace, or the channel B signal may be inverted for "subtract" operation, which is very useful for differential and distortion measurements. The chop or alternate method of dual-trace generation is selectable at sweep times of 1 ms/division and slower; alternate sweep is automatically selected at all faster sweep speeds. The matched, dual vertical amplifiers can be switched to provide vetical and horizontal deflection in X-Y operation, at the same calibrated sensitivities. A sensitive (2-volt, TTL compatible) Z-axis input permits intensity modulation from an external signal for time or frequency markers.

A wide selection of triggering modes permits a synchronized, jitter-free display of almost any waveform. With internal triggering, any signal that produces at least 1 division of vertical deflection is adequate for sweep triggering. A variable trigger threshold level and choice of negative or positive slope permits triggering at any desired point on a waveform. A selectable FIX mode bypasses the level control and automatically fixes the triggering level at the center of the trigger waveform, a real convenience when making a series of measurements at various amplitudes and dc levels. In internal triggered dual-trace operation, the channel A or channel B signal may be selected as the trigger source, or alternate triggering may be selected. With alternate triggering, two signals that are not related in frequency or time may be viewed simultaneously. Of course, external and 50/60 Hz power line triggering are also selectable, and an AUTO mode generates a sweep without an input trigger. Selectable trigger coupling includes low-frequency reject and high-frequency reject filters to attenuate interfering components for less jitter. A single sweep mode permits presentation of a non-periodic event such as a relay closure. Variable hold-off allows triggering to be inhibited beyond the normal duration after sweep completion; some complex pulse trains require variable hold-off to obtain a calibrated, synchronized display. For viewing video waveforms, a selectable built-in sync separator permits triggering from vertical or horizontal sync pulses.

Convenience features include electrical trace rotation that is adjustable from the front panel, a built-in square wave generator for probe compensation adjustment, a sturdy carrying handle that also serves as a tilt stand with a choice of several angles of tilt, and a slotted bezel for mounting a standard oscilloscope camera for making waveform photographs. The conveniently grouped and well identified controls contribute to ease of operation, and the styling is clean, modern, and attractive. Solid state, integrated construction contributes to reliability and dependability, as well as the low power consumption of 28 watts.

FEATURES

DELAYED SWEEP Permits closer examination of any portion of a waveform. Sweep trigger may be delayed from 1 microsecond to 100 milliseconds, independent of sweep rate. Permits waveform expansion up to 1000 times.

ALTERNATE DELAYED SWEEP In alternate dual-trace operation, either the channel A or channel B trace may be delayed, while the alternate trace is non-delayed for reference.

INTENSIFIED DELAYED SWEEP Selectable intensity modulation brightens delayed portion of non-delayed trace for convenient identification of delayed sweep beginning point.

ACCURATE CRT Rectangular, domed CRT provides constant electron beam length. Internal 8 x 10 division graticule reduces parallax error. Mesh type acceleration provides fine trace for accurate measurements.

HIGH BRIGHTNESS 6 kV mesh-type acceleration and bright phosphors permit waveforms to be viewed at trace duty cycle of 0.1% or less (sweep expansion of 1000 times or more).

30 MHz BANDWIDTH – 3 dB bandwidth is conservatively rated at DC to 30 MHz at 5 mV/division sensitivity for distortion free high-resolution presentation at high frequencies. Even at 2 mV/division sensitivity, bandwidth is 20 MHz.

HIGH SENSITIVITY 2 mV/division sensitivity for measurements up to 20 MHz, 5 mV/division up to 30 MHz. Permits the low-capacitance, high-impedance 10:1 attenuation probes to be used for virtually all measurements, thus assuring minimum circuit loading.

USABLE TO 50 MHz Triggers on signals to 50 MHz. Smooth roll-off above 30 MHz, response is typically down – 6 dB at 49 MHz.

11.7 ns RISE TIME Short duration pulses not viewable on other lab scopes are clearly viewable when expanded on 5X magnification. Even at 2 mV/division sensitivity, rise time is 17.5 ns.

DUAL TRACE Two input waveforms can be viewed individually or simultaneously, as desired. Completely independent adjustment of the two signal amplitudes. Alternate or chop dual-trace generation method selectable at lower sweep rates, alternate automatically selected at faster sweep rates.

TRIGGERED SWEEP Selectable trigger source; alternate, channel A, channel B, line or external. Fully variable LEVEL control allows any desired point on waveform to be used for triggering, or to set an amplitude threshold which must be exceeded to obtain a sweep.

ALTERNATE TRIGGERING In alternate dual-trace operation, the channel A trace can be triggered by the channel A signal and the channel B trace by the channel B signal. Permits simultaneous viewing of two waveforms not related in frequency or period.

AUTOMATIC SWEEP Selectable AUTO sweep operation provides sweep without trigger input, automatically switches to triggered sweep operation when adequate trigger is applied.

AUTOMATIC TRIGGER LEVEL Selectable FIX mode automatically fixes triggering level at center of trigger signal, regardless of LEVEL control setting. Saves set-up time for most waveform viewing.

SINGLE SWEEP SINGLE mode enables a single sweep, which will begin at the next sweep trigger.

HOLDOFF Variable "holdoff" period after sweep, during which trigger for next sweep is inhibited. Permits synchronization of complex pulse train at calibrated sweep rates.

LF AND HF REJECT TRIGGER COUPLING Selectable filters attenuate low or high frequency component of trigger signal for less jitter.

VIDEO CAPABILITY Selectable FRAME-LINE circuit permits triggering from vertical sync pulses (FRAME) or horizontal sync pulses (LINE) for viewing composite video waveforms.

20 CALIBRATED SWEEP SPEEDS Accurate time measurements (±3%) on 20 different ranges. Sweep speed range of 0.2 μs/div to 0.5 s/div provides every sweep speed necessary for viewing waveforms from dc to 30 MHz.

5X MAGNIFICATION A five times (5X) magnification of the horizontal sweep allows closer examination of waveforms without setting up delayed sweep operation. In addition, 5X magnification provides a maximum sweep rate of 40 ns/div.

11 CALIBRATED VOLTAGE SCALES Accurate measurement (±3%) of instantaneous voltages on 11 different ranges for both channel A and channel B (2 mV/div to 5 V/div).

SUM AND DIFFERENCE CAPABILITY Permits algebraic addition or subtraction of channel A and channel B and display as a single trace. Useful for differential voltage and distortion measurements.

X-Y OPERATION Channel B input can be applied as horizontal deflection (X axis) while channel A input provides vertical deflection (Y axis). Horizontal axis sensitivity is 2 mV/div.

Z-AXIS INPUT Intensity modulation capability permits time or frequency marks to be added. Trace brightens with 2-volt or more positive signal, TTL compatible.

BUILT-IN PROBE COMPENSATION SQUARE WAVE A built-in 0.5 volt peak-to-peak, 1 kHz square wave generator permits probe compensation adjustment and a general check of calibration accuracy.

ELECTRICAL TRACE ROTATION Trace rotation is electrically adjustable from the front panel.

REGULATED POWER SUPPLY All voltages are regulated, including high voltage for the CRT, assuring that brightness, sensitivity, and accuracy are unaffected by line voltage variations.

MECHANICAL FEATURES Carrying handle with comfortable molded finger grip also doubles as tilt stand. Locking detent each 22½° allows adjustment of viewing angle. Rear feet support oscilloscope in face-up position and double as cord wrap for storing power cord. Slotted bezel over face of CRT mounts standard oscilloscope camera for making waveform photographs.

SPECIFICATIONS

VERTICAL AMPLIFIERS (CH A and CH B)

Deflection Factor	5 mV/div to 5 V/div, ±3%. 2 mV/div, ±3%.
Attenuator	10 steps, 5 mV/div to 5 V/div in 1-2-5 sequence, plus 2 mV/div gain change step. Vernier control for fully adjustable sensitivity between steps.
Frequency Response	
5 mV/div to 5 V/div	DC: DC to 30 MHz (−3 dB). AC: 5 Hz to 30 MHz (−3 dB).
2 mV/div	DC: DC to 20 MHz (−3) dB). AC: 5 Hz to 30 MHz (−3 dB).
Rise Time	11.7 ns or less, 17.5 ns or less at 2 mV/div sensitivity.
Overshoot	3% or less (100 kHz square wave).
Input Impedance	1 MΩ, ±2%, shunted by 23 pF, ±3 pF.
Non-Distorted Maximum Amplitude	More than 8 div, DC to 30 MHz.
Maximum Input Voltage	300 V (dc + ac peak), 600 V p-p.
Operating Modes	CH A, CH B, DUAL, ADD, and subtract (using CH B invert).
Alternate-Chop Selection	TRIG SOURCE in ALT position: Alternate trace in all SWEEP TIME/div. ranges. TRIG SOURCE in any position other than ALT: Trace chopped at PULL CHOP.
Chop Frequency	Approximately 200 kHz.
Channel B Polarity	Normal or inverted.
Channel Separation	60 dB minimum.

HORIZONTAL AMPLIFIER (input thru CH B)

X-Y Operation	With SWEEP TIME/DIV switch in CH B Position, CH A input becomes Y axis (vertical) and CH B input becomes X axis (horizontal).
Deflection Factor	Same as vertical amplifier.
Input Impedance	Same as vertical amplifier.
Maximum Input Voltage	Same as vertical amplifier.
Frequency Response	DC: DC to 2 MHz (−3 dB). AC: 5 Hz to 2 MHz (−3 dB).
X-Y Phase Difference	3° or less at 100 kHz.

TIME BASE

Type	Normal: triggering sweep. Automatic: sweep free runs in absence of trigger, reverts to triggered sweep in presence of trigger. Single: when triggered, one sweep is generated. Manually reset.
Sweep Time	0.2 μs/div to 0.5 s/div ±3% in 20 ranges, in 1-2-5 sequence. Vernier control provides fully adjustable sweep time between steps.
Sweep Magnification	X5 (five times) ±10%. Extends maximum sweep rate to 40 ns/div.
Linearity	±3% all ranges (±10% on 0.5 μs/div and 0.2 μs/div range at 5X magnification).

DELAYED SWEEP

Delay Time	1 μs to 100 ms in 5 ranges with vernier adjustment.
Intensity Modulation	INTEN switch allows portion of sweep after delay to be intensified.

Independent Delay	With ALT triggering source, channel A or channel B sweep can be independently delayed.
Delay Jitter	Less than 1 part in 5,000.

TRIGGERING

Source	Alternate, channel A, channel B, line (50/60 Hz power line), and external.
Type	Normal, automatic, and single.
Slope	Positive or negative.
Level	Continuously variable or fixed. In FIX mode, level is automatically fixed at center of sync waveform.
Hold Off	Continuously variable from NORM to more than 10 times (MAX).
Coupling	AC, LF reject, HF reject, DC.
Video	FRAME-LINE switch permits triggering from horizontal (LINE) or vertical (FRAME) sync pulses of composite video signal.
Maximum External Trigger Voltage	50 V (dc + ac peak).

TRIGGER SENSITIVITY

Coupling	Bandwidth	Minimum Trigger Voltage INT (div)	Minimum Trigger Voltage EXT (V p-p)
AC	20 Hz to 25 MHz	0.5	1
	10 Hz to 30 MHz	1	5
DC	DC to 25 MHz	0.5	1
	DC to 30 MHz	1	5
FIX	40 Hz to 20 MHz	0.5	1
	20 Hz to 25 MHz	1	5
LF Rej:	Attenuate below 10 kHz.		
HF Rej:	Attenuate above 100 kHz.		

Z-AXIS INPUT (Intensity Modulation)

Sensitivity	2 V p-p minimum (TTL compatible). Positive voltage increases brightness, negative voltage decreases brightness.
Usable Frequency Range	DC to 5 MHz.
Input Impedance	10 kΩ.
Maximum Input Voltage	50 V (dc + ac peak).

POWER REQUIREMENTS

Input	120/240 VAC, 50/60 Hz, 30 watts.
Regulation	105 to 130 VAC.

OTHER SPECIFICATIONS

Trace Rotation	Electrical, adjustable from front panel.
CRT	140 mm rectangular CRT (approx. 5″), internal 8 x 10 division graticule, 1 division = 9.5 mm.
Accereration Voltage	6 kV.
Calibration Voltage	0.5 V p-p ± 1% square wave; positive polarity, reference level 0V. 1 kHz ± 3%.
Dimensions (HWD) without Handle	19 x 26 x 37.5 cm (7-3/8 x 10-1/8 x 14-3/4″).
Weight	8.6 kg (19 lbs.).

PROBES

Model No.	PR-37.
Attenuation	10:1 and direct.
Input Impedance	10:1 = 10 megohm, 18 pF. Direct = 1 megohm, 40 pF.
Connector	BNC male.
Frequency Response	100 MHz.

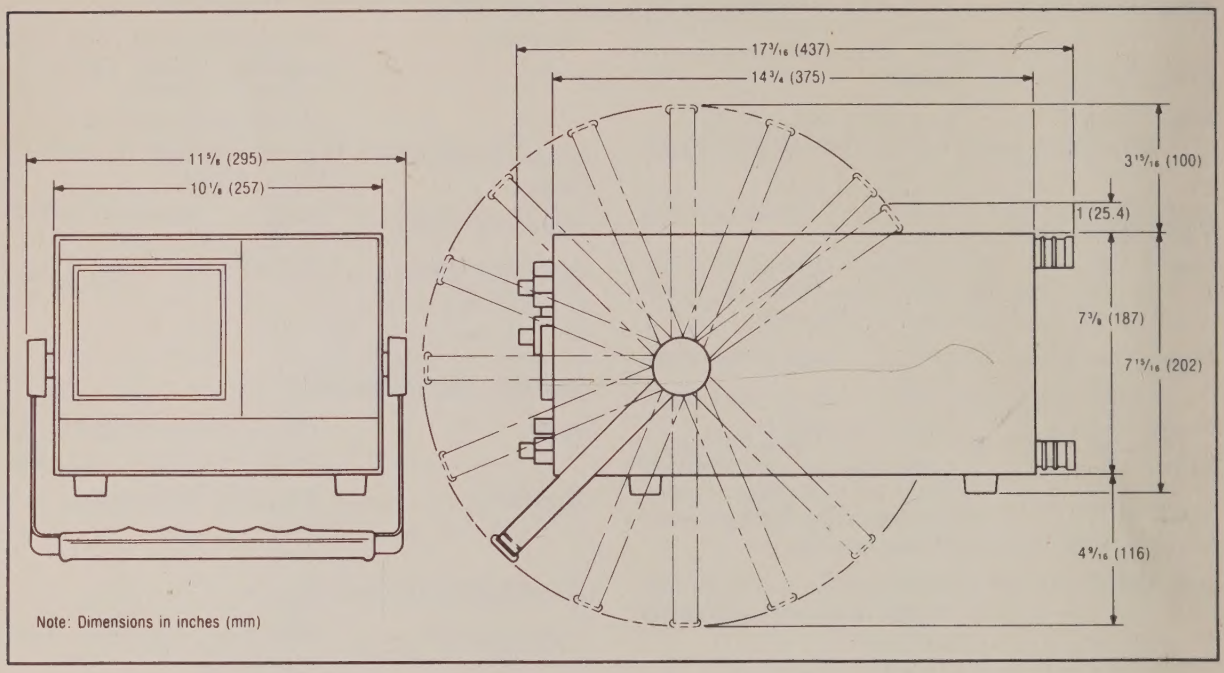

Fig. 1. Dimensional Drawing

CONTROLS AND INDICATORS

All pushbutton switches on this oscilloscope are alternate action type. Press once to engage (button stays in). Press again to release (button returns to out position).

GENERAL CONTROLS (1 - 10)

1. **MODE Switch.** Four-position lever switch; selects the basic operating modes of the oscilloscope.

   CH A Only the input signal to channel A is displayed as a single trace.

   CH B Only the input signal to channel B is displayed as a single trace.

   DUAL Dual-trace operation; both the channel A and channel B input signals are displayed on two separate traces.

   ADD The waveforms from channel A and channel B inputs are added and the sum is displayed as a single trace. When the CH B POLARITY button is engaged (INV), the waveform from channel B is subtracted from the channel A waveform and the difference is displayed as a single trace.

2. **TRACE ROTATION Control.** Electrically rotates trace to horizontal position.

3. **ASTIG Adjustment.** Astigmatism adjustment provides optimum spot roundness when used in conjunction with FOCUS and INTENSITY controls. Very little readjustment of this control is required after initial adjustment.

4. **FOCUS Control.**

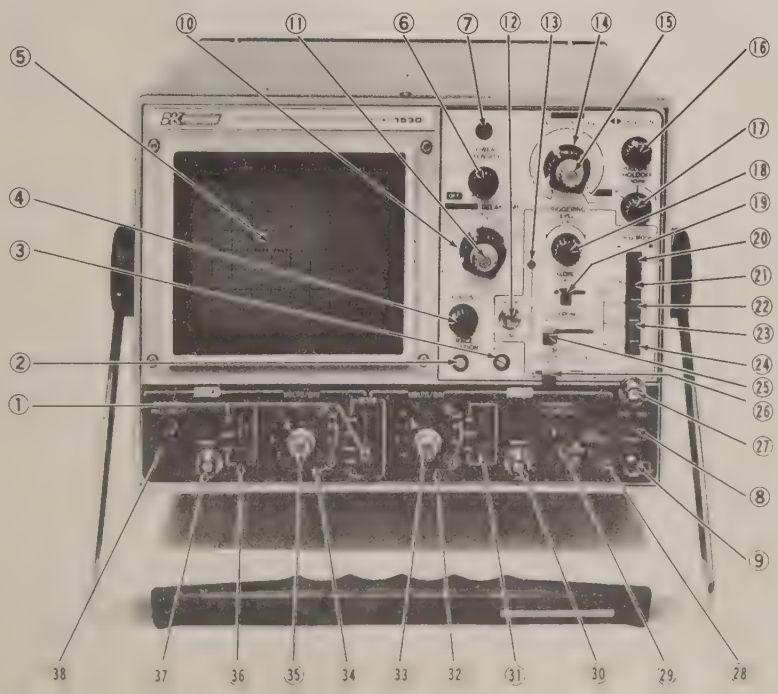

Fig. 2. Front panel controls and indicators

5. **Cathode Ray Tube (CRT).** This is the screen on which the waveforms are viewed. This rectangular CRT has in internal 8 x 10 division graticule scale which reduces parallax error to minimum.
6. **INTENSITY Control.** Fully counterclockwise rotation of this control (OFF position) turns off oscilloscope. Clockwise rotation turns on oscilloscope. Further clockwise rotation of the control increases the brightness of the trace.
7. **POWER Indicator.** Glows when oscilloscope is turned on.
8. **CAL 1 kHz ⎍ 0.5 V p-p Terminal.** Provides 1 kHz, 0.5-volt peak-to-peak square wave signal. This is useful for probe compensation adjustment and a general check of oscilloscope calibration accuracy.
9. **⏚ Terminal/Binding Post.** Earth and chassis ground.

SWEEP AND TRIGGERING CONTROLS (10 - 27)

10. **DELAY TIME Switch.** Range selector switch permits coarse selection of delay time for delayed sweep operation (this control has no effect unless one or more of the TRIG DELAY buttons is engaged . . . INTEN, CH A DLY'D, or CH B DLY'D). Five ranges of 1 to 10μs, 10 to 100 μs, .1 to 1 ms, 1 to 10 ms, and 10 to 100 ms.
11. **Delay Time VARIABLE Control.** Fine adjustment of delay time within selected range. Fully counterclockwise rotation is minimum delay time, clockwise rotation increases delay time.
12. **SINGLE Switch.** Three-position toggle switch with the following positions:

    NORM Normal sweep, used for all types of operation except single sweep.

    center

    RESET This is a momentary action position; switch returns to center position when released. Enables single sweep operation. A single sweep will begin when the next sync trigger occurs. After a single sweep, switch must be momentarily RESET to enable next single sweep. When held in RESET position, spot illumination brightens the entire CRT screen to accentuate the graticule scale for waveform photographs.
13. **Single READY Indicator.** Lights to indicate single sweep operation is ready for triggering. Lights when RESET switch is operated and goes off when single sweep is completed.
14. **SWEEP TIME/DIV Switch.** Horizontal coarse sweep time selector. Selects calibrated sweep times of 0.2 μs/div (microsecond per division) to 0.5 s/div in 20 steps when sweep time VARIABLE control is set to CAL position (fully clockwise). In the CH B position, this switch disables the internal sweep generator and permits the CH B input to provide horizontal deflection (X-Y operation).
15. **Sweep Time VARIABLE Control.** Fine sweep time adjustment. In the extreme clockwise (CAL) position the sweep time is calibrated.
16. **◄►POSITION Control.** Rotation adjusts horizontal position of trace (both traces in DUAL mode). Push-pull switch selects 5X magnification (PULL 5X MAG) when pulled out; normal when pushed in.
17. **HOLDOFF Control.** Rotation adjusts holdoff time (trigger inhibit period beyond sweep duration). Fully counterclockwise rotation is NORM, clockwise rotation increases holdoff period. Push-pull switch selects chop or alternate method of dual-trace generation; chop when pulled out (PULL CHOP), alternate when pushed in (except alternate method is always selected when SOURCE switch is in ALT position.
18. **LEVEL Control.** Trigger level adjustment determines point on waveform where sweep starts. Rotation in (−) direction selects more negative point of triggering, and rotation in (+) direction selects more positive point of triggering. Push-pull switch selects automatic triggering when pulled out (PULL AUTO). With automatically triggering, a sweep is generated automatically (free runs) in the absence of trigger signal; reverts to triggered sweep operation in the presence of adequate trigger signal.
19. **SLOPE Switch.** Two-position lever switch with the following positions:

    (+) Sweep is triggered on positive-going slope of waveform, or with positive sync pulse of composite video waveform.

    (−) Sweep is triggered on negative-going slope of waveform, or negative sync pulse of composite video waveform.

20. **FIX-NORM Button.** In the FIX position (button engaged), the triggering level is automatically fixed at the center of the triggering waveform, regardless of the position of the LEVEL control. In the NORM position, (button released), variable triggering level is enabled.

21. **FRAME-LINE Button.** In the FRAME position (button engaged), vertical sync pulses of a composite video signal are selected for triggering. In the LINE position (button released), horizontal sync pulses of a composite video signal are selected for triggering. The LINE position is also used for all non-video waveforms.

22. **INTENsify Button.** When this button is engaged, the first position of the trace(s) is of normal intensify, and the delayed sweep portion is brighter, or intensified. The beginning of the brighter portion. identifies the starting point of delayed sweep. The delay time period is variable with the DELAY TIME controls (10 and 11). Normal nonintensified trace when switch is OFF (button released).

23. **CH A DLY'D Button.** When this button is engaged, the beginning of the channel A trace is delayed by the period selected with the DELAY TIME controls. Normal non-delayed trace when switch is OFF (button released).

24. **CH B DLY'D Button.** When this button is engaged, the beginning of the channel B trace is delayed by the period selected with the DELAY TIME controls. Normal non-delayed trace when switch is OFF (button released).

25. **COUPLING Switch.** Four-position lever switch with the following positions:

    AC Trigger is ac coupled. 10 Hz to 30 MHz response.

    LF Rej Triggering below 10 kHz is attenuated.

    HF Rej Triggering above 100 kHz is attenuated.

    DC Trigger is dc coupled. DC to 30 MHz response.

26. **SOURCE Switch.** Five-position lever switch selects triggering source for the sweep, with the following positions:

    ALT Alternate triggering in DUAL mode; channel A trace is triggered by channel A signal and channel B trace is triggered by channel B signal. Scope operates in alternate sweep method regardless of setting of PULL CHOP switch.

    In CH A and ADD mode, sweep is triggered by channel A signal.

    In CH B mode, sweep is triggered by channel B signal.

    CH A Sweep is triggered by channel A signal regardless of MODE selection.

    CH B Sweep is triggered by channel B signal regardless of MODE selection.

    LINE Sweep is triggered by line voltage (60 Hz in USA).

    EXT Sweep is triggered by signal applied to EXT TRIG jack.

27. **EXT TRIG Jack.** Input terminal for external trigger signal.

CHANNEL B CONTROLS (28 - 33)

28. **CH B POLARITY Button.** In the NORM position (button released), the channel B signal is noninverted. In the INV position (button engaged), the channel B signal is inverted. In the ADD mode, and this switch in INV, the channel B signal is subtracted from the channel A signal and the difference is displayed as a single trace.

29. **POSITION Control.** Rotation adjusts vertical position of channel B trace. In X-Y operation rotation adjusts horizontal position of display. Push-pull switch (PULL 5►2 mV) selects channel B sensitivity when VOLTS/DIV switch is set to most sensitive range. Pull for 2 mV/div sensitivity, push for 5 mV/div sensitivity.

30. **INPUT Jack.** Vertical input for channel B trace in normal sweep operation. External horizontal input in X-Y operation.

31. **AC-GND-DC Switch.** Three-position lever switch which operates as follows:

    AC Blocks dc component of channel B input signal.

    GND Opens signal path and grounds input to vertical amplifier. This provides a zero-signal base line, the position of which can be used as a reference when performing dc measurements.

    DC Direct input of ac and dc component of channel B input signal.

32. **VOLTS/DIV Switch.** Vertical attenuator for channel B; provides step adjustment of vertical sensitivity. When VARIABLE control (33) is set to CAL, vertical sensitivity is calibrated in 10 steps from 5 V/div to 5 mV/div (2 mV/div when POSITION control is pulled). In X-Y operation, this control provides step adjustment of horizontal sensitivity.

33. **VARIABLE Control.** Rotation provides fine control of channel B vertical sensitivity. In the fully clockwise (CAL) position, the vertical attenuator is calibrated. In X-Y operation, this control becomes the fine horizontal gain control.

CHANNEL A CONTROLS (34 - 38)

34. **VOLTS/DIV Switch.** Vertical attenuator for channel A; provides step adjustment of vertical sensitivity. When VARIABLE control (35) is set to CAL, vertical sensitivity is calibrated in 10 steps from 5 V/div to 5 mV/div (2 mV/div when POSITION control is pulled).

35. **VARIABLE Control.** Rotation provides fine control of channel A vertical sensitivity. In the fully clockwise (CAL) position, the vertical attenuator is calibrated.

36. **AC-GND-DC Switch.** Three-position lever switch which operates as follows:

    AC Blocks dc component of channel A input signal.

    GND Opens signal path and grounds input to vertical amplifier. This provides a zero-signal base line, the position of which can be used as a reference when performing dc measurements.

    DC Direct input of ac and dc component of channel A input signal.

37. **INPUT Jack.** Vertical input for channel A trace. Vertical input for X-Y operation.

38. **POSITION Control.** Rotation adjusts vertical position of channel A trace. In X-Y operation, rotation adjusts vertical position of display. Push-pull swith (PULL 5►2 mV) selects channel A sensitivity when VOLTS/DIV switch is set to most sensitive range. Pull for 2 mV/div sensitivity, push for 5 mV/div sensitivity.

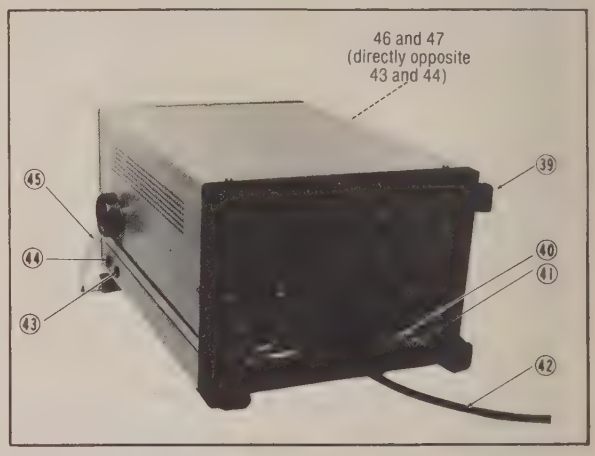

Fig. 3. Rear and side panel facilities.

ADDITIONAL FACILITIES (See Fig. 3)

39. **Cord Wrap/Feet.** Support oscilloscope in vertical position (face up) and serve as cord wrap for storing power cord.

40. **Fuse Holder.**

41. **Z AXIS INPUT Jack.** External intensity modulation input.

42. **AC Power Cord.**

43. **VR108. CH B STEP ATT. BAL Control** (under rubber plug). Screwdriver adjustment for channel B trace step attenuator balance.

44. **VR106. CH B VARI. BAL Control** (under rubber plug). Screwdriver adjustment for channel B trace vertical dc balance.

45. **Combination Carrying Handle and Tilt Stand.** When the handle is folded upward, the oscilloscope rests on rubber feet. When the handle is folded downward, it elevates the front of the oscilloscope to a convenient viewing angle. Press in both pivot points to unlock and rotate the handle. Handle locks at each 22½° angle of rotation.

46. **VR103. CH A STEP ATT. BAL Control** (under rubber plug). Screwdriver adjustment for channel A trace step attenuator balance.

47. **VR101. CH A VARI. ATT. BAL Control** (under rubber plug). Screwdriver adjustment for channel A trace vertical dc balance.

OPERATING INSTRUCTIONS

PRECAUTIONS

Safety

WARNING

The following precautions must be observed to prevent electric shock.

1. When this oscilloscope is used to make measurements in equipment that contains high voltage, there is always a certain amount of danger from electric shock. The person using the oscilloscope in such conditions should be a qualified electronics technician or otherwise trained and qualified to work in such circumstances. Observe the "Test Instrument Safety" recommendations listed on the inside front cover of this manual.
2. The ground wire of the 3-wire ac power plug places the chassis and housing of the oscilloscope at earth ground. Do not attempt to defeat the ground wire connection or float the oscilloscope; to do so may pose a great safety hazard.
3. One of the most commonly encountered shock hazards is testing of "hot chassis" transformerless ac-powered equipment (see item 4 on the inside front cover for a full explanation of the hazard). Never attempt to make oscilloscope measurements in such equipment without first connecting an isolation transformer between the ac power line and the equipment under test. To be on the safe side, treat all equipment as "hot chassis" unless you are sure it has an isolated chassis or earth ground chassis.

Equipment Protections

CAUTION

The following precautions will help avoid damage to the oscilloscope.

1. Never allow a small spot of high brillance to remain stationary on the screen for more than a few seconds. The screen may become permanently burned. A spot will occur only when the scope is set up for X-Y operation and no signal is applied. Either reduce the intensity so the spot is barely visible, switch back to normal sweep operation when no signal is applied, or set up the scope for spot blanking.
2. Never cover the ventilating holes in the side of the oscilloscope, as this will increase the operating temperature inside the case.
3. Never apply more than the rated 300 volts dc + ac peak or 600 volts peak-to-peak (212 volts rms for sine wave) to the oscilloscope inputs. When the probes are set for 10:1 attenuation, the voltage at the scope input is only 1/10 of that at the point of measurement, however, do not exceed the 600 volts dc + ac peak probe rating at the point of measurement.
4. Always connect a cable from the earth ground (⏚) jack of the oscilloscope to the chassis of the equipment under test. Without this precaution, the entire current for the equipment under test may be drawn through the probe clip leads under certain circumstances. Such conditions could also pose a safety hazard, which the ground cable will prevent.
5. The probe ground clips are at earth ground and should be connected only to the common of the equipment under test. To measure with respect to any point other than the common, use the "Differential Voltage Measurement" technique, with the Channel A probe to the point of reference and the Channel B probe to the point of measurement.

OPERATING TIPS

The following recommendations will help obtain the best performance from the oscilloscope.

1. Always use the probe ground clips for best results. Do not use an external ground wire in lieu of the probe ground clips, as undesired signals may be introduced.

2. Operation adjacent to equipment which produces strong ac magnetic fields should be avoided where possible. This includes such devices as large power supplies, transformers, electric motors, etc., that are often found in an industrial environment. Strong magnetic fields can exceed the practical CRT magnetic shielding limits and result in interference and distortion.

3. Probe compensation adjustment matches the probe to the input of the scope. For best results, compensation of both probes should be adjusted initially, then the same probe always used with channel A and channel B respectively. Probe compensation should be readjusted whenever a probe from a different scope is used, or the channel A and B probes are interchanged. Adjust the compensation trimmer on each probe for the best quality waveshape (minimum overshoot, rounding off, and tilt), while observing the calibration square wave from the CAL 1 kHz ⎍⎍ 0.5 V p-p terminal.

4. Occasionally check trace rotation, dc balance, astigmatism, and calibration accuracy of the scope using the procedures found in the OPERATOR MAINTENANCE section of this manual.

INITIAL STARTING PROCEDURE

Until you familiarize yourself with the use of all controls, the following procedure may be used to standardize the initial setting of controls as a reference point and to obtain a trace on the CRT in preparation for waveform observation.

1. Set INTENSITY control to OFF (fully counterclockwise).

2. Connect power cord to a 120-volt, 50/60 Hz outlet. Operation from 100 volts, 220 volts, or 240 volts, 50/60 Hz ac is also possible if the oscilloscope is first set up for such operation. Procedures are given in the SERVICING portion of this manual.

3. Set CH A POSITION control, CH B POSITION control and ◄ ►POSITION control to the centers of their ranges. The push-pull switch on each of these controls should be pushed in.

4. Set CH A AC-GND-DC switch and CH B AC-GND-DC switch to the GND positions.

5. Set the SINGLE switch to the NORM position.

6. Set the MODE switch to the DUAL position for dual-trace operation. It will be desirable to display both traces when making the centering adjustments in step 13.

7. In triggered sweep operation, the trace remains at rest and is blanked until an input signal is applied for triggering. In automatic sweep operation, a trace is generated without an input signal. Since no input signal will be applied initially, select automatic sweep by pulling outward on the triggering LEVEL control (PULL AUTO).

8. Set SWEEP TIME/DIV switch to 1 mS position. Any position except CH B may be used, but 1 mS is a good starting point.

9. Turn on oscilloscope by turning INTENSITY control clockwise. The POWER pilot light will glow.

10. Wait a few seconds for the cathode ray tube (CRT) to warm up. Two traces should appear on the face of the CRT.

11. If no trace appears, increase (clockwise) the INTENSITY control setting until the trace is easily observed.

12. Adjust FOCUS control and INTENSITY control for the thinnest, sharpest trace.

13. Readjust POSITION controls if necessary, to position the traces for convenient viewing, with the channel A trace above the channel B trace and with both traces starting at the left edge of the graticule scale.

14. Check for proper adjustment of TRACE ROTATION and ASTIG controls and dc balance adjustments as described in the OPERATOR MAINTENANCE section of this manual. These adjustments require checking only periodically.

15. Controls may be set to the following positions as a starting point for most waveform observation.

    SINGLE switch unchanged from step 5 (NORM position).

    SWEEP TIME/DIV switch unchanged from step 8 (1 mS), and sweep time VARIABLE control to CAL (fully clockwise).

    FOCUS and INTENSITY controls unchanged from step 12.

    POSITION controls unchanged from step 13.

    MODE switch to CH B for single-trace operation or DUAL for dual-trace operation.

    CH A and CH B AC-GND-DC switches to AC.

CH A and CH B VOLTS/DIV controls to 5V positions, and VARIABLE controls to CAL (fully clockwise).

CH B POLARITY button to NORM (out).

SOURCE switch to ALT.

COUPLING switch to AC.

SLOPE switch to "+".

Triggering LEVEL control centered and push-pull switch (PULL AUTO) pushed in. The trace(s) will disappear until adequate input signal is applied for sweep triggering.

HOLDOFF control to NORM, and push-pull switch (PULL CHOP) pushed in.

All TRIG MODE pushbuttons to out positions, as follows:

FIX-NORM to NORM
FRAME-LINE to LINE
INTEN, CH A DLY'D and CH B DLY'D to OFF

DELAY TIME switch and delay time VARIABLE control may be left in any position.

16. The oscilloscope is now ready for waveform observation.

WAVEFORM OBSERVATION

Single Trace

Either channel A or channel B can be used for single-trace operation. The advantage of using channel B is that the polarity of the observed waveform can be inverted, if desired, with the CH B POLARITY switch. For convenience, channel B is used in the following instructions:

1. Performs the steps of the INITIAL STARTING PROCEDURE with the MODE switch in the CH B position. Then connect the probe cable to the CH B INPUT jack.
2. For all except very low-amplitude waveforms, the probes are set for 10:1 attenuation. For very low-amplitude waveforms (below 20 millivolts peak-to-peak), set the probe for DIRECT. The 10:1 setting, with its higher input impedance and lower shunting capacitance, should be used when possible to decrease circuit loading.
3. Set CH B AC-GND-DC switch to AC for measuring only the ac component (this is the normal position for most measurements and must be used if the point being measured includes a large dc component). Use the DC position for measuring both the ac component and the dc reference, and any time a very low frequency waveform (below 10 Hz) is to be observed. The GND position is required only when a zero-signal ground reference is required, such as for dc voltage readings.
4. Connect ground clip of probe to chassis or common of the equipment under test. Connect the tip of the probe to the point in the circuit where the waveform is to be measured.
5. If no trace appears, turn the CH B VOLTS/DIV switch clockwise until a trace does appear. If the switch is rotated all the way to the 5 mV range and no trace has appeared, pull the CH B POSITION control knob (PULL 5►2 mV). This increases vertical sensitivity to 2 mV per division.

NOTE

The initial 5V setting of the VOLTS/DIV control recommended in the INITIAL STARTING PROCEDURE offers the greatest protection against accidental overvoltage when the probe is first touched to the point of measurement. However, initial sensitivity with a 10:1 probe is 50 volts per division, and there usually won't adequate signal for sweep triggering. Turning the VOLTS/DIV switch clockwise increases vertical sensitivity. When sensitivity is increased adequately for the input signal to produce 1 division or more vertical deflection (with triggering LEVEL control centered), the sweep is triggered and a trace appears. If no trace is obtainable, refer to the following TRIGGERING procedures.

6. Set CH B VOLTS/DIV switch and VARIABLE control to a position that gives 2 to 6 divisions of vertical deflection. The display on the screen will probably be unsynchronized. Refer to TRIGGERING procedures below for adjusting synchronization and sweep speed to obtain a stable display showing the desired number of waveforms.

Dual Trace (Refer to Fig. 4)

In observing simultaneous waveforms on channel A and B, the waveforms are usually related in frequency, or one of the waveforms is synchronized to the other, although the basic frequencies are different. One common application is in digital circuits where virtually all waveforms are related to a master "clock" frequency. If the two waveforms have no phrase or frequency relationship, there is seldom reason to observe both waveforms simultaneously.

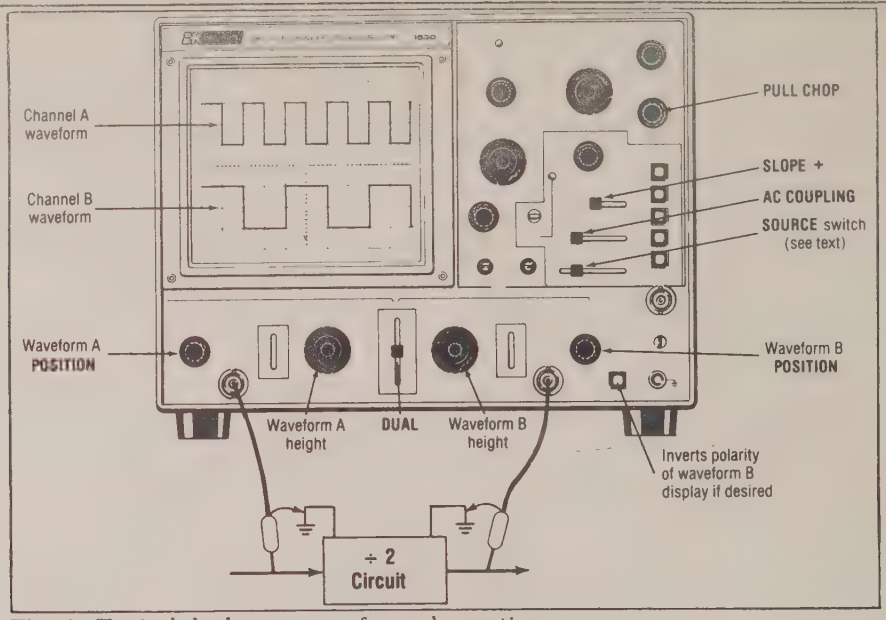

Fig. 4. Typical dual-trace waveform observation.

To display two waveforms simultaneously for observation use, the following procedure:

1. Perform the steps of the INITIAL STARTING PROCEDURE.
2. Connect oscilloscope probe cables to both the CH A and CH B INPUT jacks.
3. For all except very low-amplitude waveforms, the probes are set for 10:1 attenuation. For very low-amplitude waveforms (below 20 millivolts peak-to-peak), set the probes for DIRECT. The 10:1 setting, with its higher input impedance and lower shunting capacitance, should be used when possible to decrease circuit loading.
4. Set CH A and CH B DC-GND-AC switches to AC for measuring only the ac component (this is the normal position for most measurements and must be used if the point being measured includes a large dc component). Use the DC position for measuring both ac component and the dc reference, and any time a very low frequency waveform (below 10 Hz) is to be observed. The GND position is required only when a zero-signal ground reference is required, such as for dc voltage readings.
5. Connect the ground clips of the probes to the chassis or common of the equipment under test. Connect the tips of the probes to points in the circuit where the waveforms are to be measured.
6. Set MODE switch to the DUAL position. Two traces should appear on the screen.
7. If no traces appear, set the SOURCE switch to CH A and turn the CH A VOLTS/DIV switch clockwise until the traces appear. If the VOLTS/DIV switch is rotated all the way to the 5 mV range and no traces have appeared, pull the CH A POSITION control knob (PULL 5►2 mV). This increases vertical sensitivity to 2 mV/division.

NOTE

The initial 5V setting of the VOLTS/DIV switches recommended in the INITIAL STARTING PROCEDURE offers the greatest protection against accidental overvoltage when the probes are first touched to the points of measurement. However, initial sensitivity with 10:1 probes is 50 volts per division and there usually won't be adequate signal for sweep triggering. Turning the CH A VOLTS/DIV switch clockwise increases the channel A vertical sensitivity. When sensitivity is increased adequately for the input signal to produce 1 division or more vertical deflection (with triggering LEVEL control centered), the sweep is triggered and both traces appear. If no trace is obtainable, refer to the following TRIGGERING procedures.

8. Adjust CH A and CH B POSITION controls to place the channel A trace above the channel B trace, and adjust both traces to a convenient reference mark on the scale.

9. The alternate method of dual-trace generation is always selected when the SOURCE switch is in the ALT position (a necessity for alternate triggering). Otherwise, the alternate or chop method of dual-trace operation may be selected at any sweep speed. The alternate-chop selection is made manually with the HOLDOFF/PULL CHOP control (pull for chop, push for alternate). The alternate method is normally used for viewing high-frequency or high-speed waveforms at sweep times of 0.5 ms/-div to 0.2μs/div. The chop method is normally used for low-frequency or low-speed wavefoums at sweep times of .5 second/div to 1 ms/div. If chop sweep is used at frequencies above 5 kHz (sweep time of 0.2 ms/div and faster), the chop rate becomes a significant portion of the sweep and may become visible in the displayed waveform. However, you may select alternate or chop operation at any sweep speed for special applications. For example, the only way to view simultaneous events on a dual-trace scope at any sweep speed is with chop sweep.

10. Set the VOLTS/DIV switches and VARIABLE controls for channels A and B to a position that gives 2 to 3 divisions of vertical deflection for each trace. The displays on the screen will probably be unsynchronized. Refer to TRIGGERING procedures below for adjusting synchronization and sweep speed to obtain a stable display showing the desired number of waveforms.

TRIGGERING

The Model 1530 Oscilloscope provides full versatility in the selection and adjustment of sync triggering for maximum ability to obtain a stable, jitter-free display in single-trace and dual-trace operation. The following steps are concerned with setting controls to obtain a stable, synchronized display. The proper control settings depend upon the type of waveform being observed and other factors. An explanation of the various control settings which affect synchronization of the display is given to help you select the proper settings over a wide range of conditions.

1. SOURCE Switch.

Triggered sweep operation is normally used with this oscilloscope. In triggered sweep operation, the sweep remains at rest until triggered by a sync pulse. The SOURCE switch selects the input signal that is to be used to trigger the sweep, with four INTernal sync possibilities and one EXTernal sync possibility.

a. INTernal Sync Positions.

(1) **ALTernate position.** Operates in conjunction with MODE switch to use waveform(s) being observed as sync trigger. Specifically, when MODE switch is in CH A and ADD modes the channel A input signal becomes the sync trigger, in the CH B mode, the channel B input signal becomes the sync trigger, and in the DUAL mode, the channel A and channel B input signals alternately become sync triggers for the A and B trace respectively.

IMPORTANT

The ALT position is probably the most commonly used setting of the SOURCE switch, and is very convenient for checking amplitude, observing the wave shape, or measuring the time duration of the waveform(s). However, for phase or timing comparisons between the channel A and channel B waveforms, both traces must be triggered by the *same* sync signal. Use any position *except* ALT for such measurements. Also, the ALT position selects the alternate sweep method of dual-trace genertion and cannot be used when the chop sweep method is desired. In dual-trace operation, alternate source triggering requires adequate trigger signal on both channel A and B to sustain triggered sweep. If either signal is missing or falls below the triggering threshold level, no sweep will be generated. In such cases, AUTO sweep may be selected to obtain a dual-trace display.

(2) **CH A position.** In this position, the input signal at the channel A INPUT jack becomes the trigger regardless of the position of MODE switch. Maximum trigger sensitivity at the channel A input jack is 2 millivolts peak-to-peak.

(3) **CH B position.** In this position, the input signal at the channel B INPUT jack becomes the trigger regardless of the position of MODE switch. Maximum trigger sensitivity at the channel B INPUT jack is 2 millivolts peak-to-peak.

(4) **LINE Position.** In this position, the ac line voltage powering the oscilloscope (60 Hz in USA) is used as sync triggering. This is useful for observing waveforms that are related to the power line frequency such as power supply ripple, or a common reference for phase shift measurements at various points in line frequency related circuits.

b. EXTernal Sync Position.

In this position, the input signal at the EXTernal TRIGger jack becomes the trigger. This signal must have a time or frequency relationship to the signal being observed to synchronize the display. External sync is preferred for waveform observation in many applications. For example, in digital circuits where several time-related waveforms are present, as reference phase when observing phase shift at several points in non-LINE frequency related circuits, and in signal tracing to eliminate triggering readjustment at each point of measurement.

External triggering has a minimum sensitivity of 0.5 volt, and will often trigger on signals as low as 0.1 volt. The maximum input voltage rating is 50 volts (dc + ac peak). If the external trigger signal amplitude is too high, the triggering point cannot be adjusted satisfactorily with the triggering LEVEL control. If this occurs use a 10:1 oscilloscope probe for the external sync signal to attenuate the trigger to a more suitable level. This method also extends the maximum external triggering voltage that may be used.

2. COUPLING Switch.

a. AC Position.

Most commonly used position; permits triggering from 10 Hz to over 30 MHz. Blocks dc component of sync trigger signal.

b. LF Rej Position.

Attenuates trigger signals below 10 kHz. Useful to reduce low-frequency interference such as 60 Hz hum (see Fig. 5A).

c. HF Rej Position.

Attenuates trigger signals above 100 kHz. Useful to reduce high-frequency noise (see Fig. 5B), and permits triggering from the modulation envelope of an amplitude modulated rf signal.

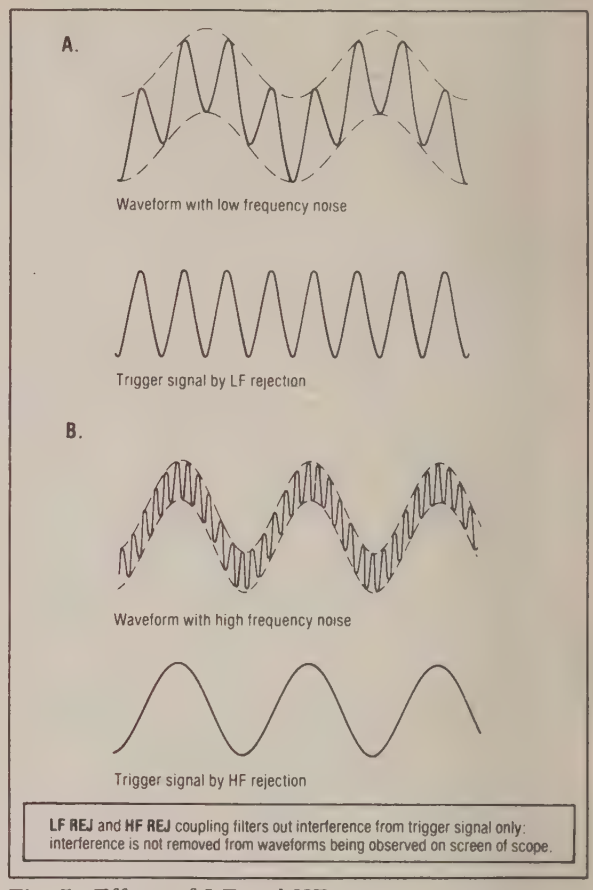
A.
Waveform with low frequency noise
Trigger signal by LF rejection
B.
Waveform with high frequency noise
Trigger signal by HF rejection
LF REJ and HF REJ coupling filters out interference from trigger signal only: interference is not removed from waveforms being observed on screen of scope.

Fig. 5. Effects of LF and HF rejection in sync coupling.

d. DC Position.

Permits triggering from dc to over 30 MHz. Couples dc component of sync trigger signal. Useful for triggering from very low frequency signals (below 10 Hz), or ramp waveforms with slow repeating dc.

3. SLOPE Switch. (see Fig. 6)

a. + Position.

A sweep trigger is developed from the trigger source signal as it crosses a threshold level in a *positive-going* direction.

b. – Position.

A sweep trigger is developed from the trig-

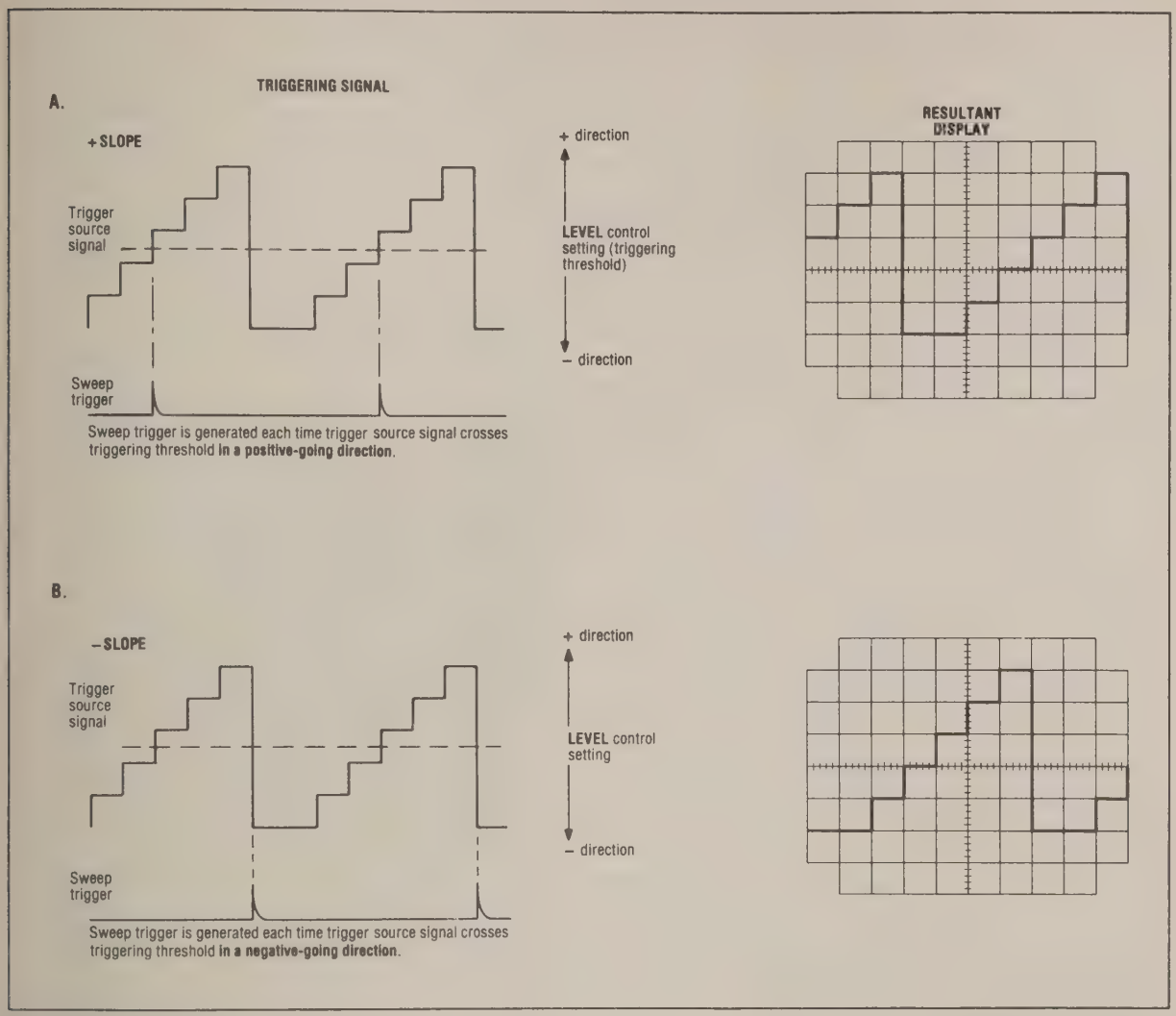

Fig. 6. SLOPE selection

ger source signal as it crosses a threshold level in a *negative-going* direction.

4. Triggering LEVEL Control.

Rotation of the triggering LEVEL control varies the triggering threshold level as illustrated in Fig. 7. In the + direction (clockwise), the triggering threshold shifts to a more positive value, and in the – direction (counterclockwise), the triggering threshold shifts to a more negative value. When the control is centered, the threshold level is set at the approximate average of the signal used as the triggering source. Note that if the triggering LEVEL control is rotated toward its extreme + or – setting, that no sweep will be developed in the normal triggered sweep mode because the triggering threshold exceeds the peak amplitude of the sync signal.

When the triggering LEVEL control is pulled outward (PULL AUTO), automatic sweep operation is selected. In automatic sweep operation, the sweep generator free-runs to generate a sweep without a trigger signal (this is also called recurrent sweep operation), but automatically switches to triggered sweep operation if an acceptable trigger source signal is present. The AUTO position is handy when first setting up the scope to observe a waveform; it provides sweep for waveform observation until other controls can be properly set. Automatic sweep operation *must* be used for dc

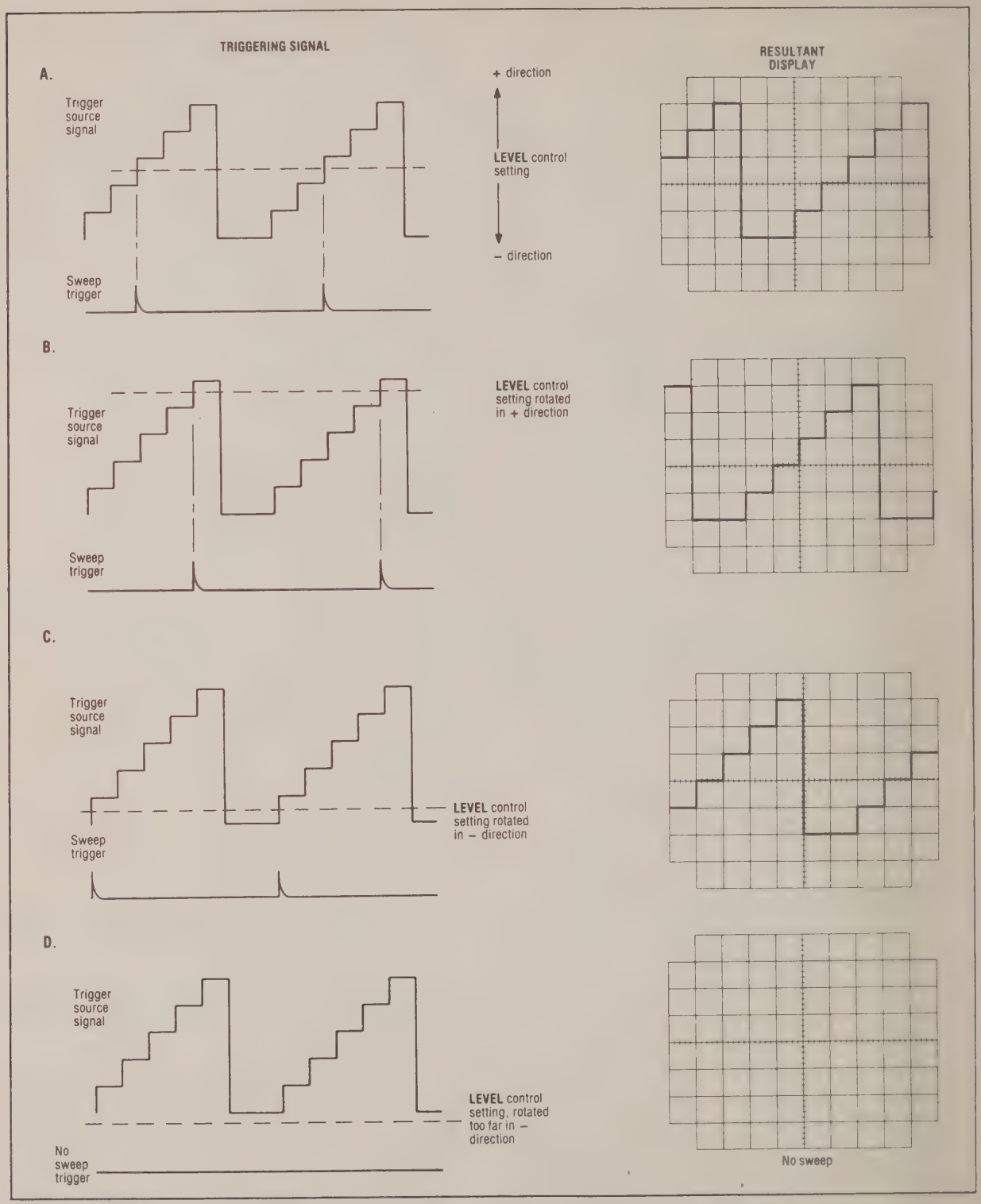

Fig. 7. Effects of varying LEVEL control setting ("+" SLOPE used in all examples).

measurements and signals of such low amplitude that they will not trigger the sweep. Typically, signals that produce even ½ division of vertical deflection are adequate for normal triggered sweep operation.

In AUTO operation, the LEVEL control still selects the triggering threshold at which the scope will switch from automatic sweep to triggered sweep operation.

The examples shown in Fig. 7 use a staircase waveform. However, any waveshape will produce a sweep trigger when it passes through the triggering threshold. Rotation of the LEVEL control adjusts the start of the sweep to almost any desired point on a waveform. On sine wave signals, the phase at which sweep begins is variable. For any type signal, the LEVEL control can be used to set an amplitude threshold which must be exceeded to obtain a sweep. This permits the oscilloscope to serve as an amplitude threshold detector, or prevents triggering by noise or an undesired portion of a waveform. When DC COUPLING is used, the dc component of the trigger source signal must also be considered when setting the triggering LEVEL control (see Fig. 8).

In dual-trace, triggered sweep operation using alternate source triggering, both signals must exceed the triggering threshold to obtain a sweep. Both traces may be displayed by switching to AUTO sweep. Examination of the display should indicate whether the channel A or channel B signal, or both, has caused the loss of triggering.

5. HOLDOFF Control.

A "holdoff" period occurs immediately after the completion of each sweep, and is a period during which triggering of the next sweep is inhibited. The normal holdoff period varies with the sweep rate, but is adequate to assure complete retrace and stabilization before the next sweep trigger is permitted. The HOLDOFF control allows this period to be extended by a variable amount if desired.

This control is usually set to the NORM position (fully counterclockwise) because no additional holdoff period is necessary. The HOLDOFF control is useful when a complex series of pulses appear periodically, such as in Fig. 9A. Improper sync may produce a double image as in Fig. 9B. Such a display could be synchronized with the sweep time VARIABLE control, but this is impractical because time measurements are then uncalibrated. An alternate method of synchronizing the display is with the HOLDOFF control. The sweep speed remains the same, but the triggering of the next sweep is "held off" by the duration selected by the HOLDOFF control. Turn the HOLDOFF control clockwise from the NORM position until the sweep starts at the same point of the waveform each time. At the MAX setting, the holdoff period is about 10 times greater than at the NORM setting.

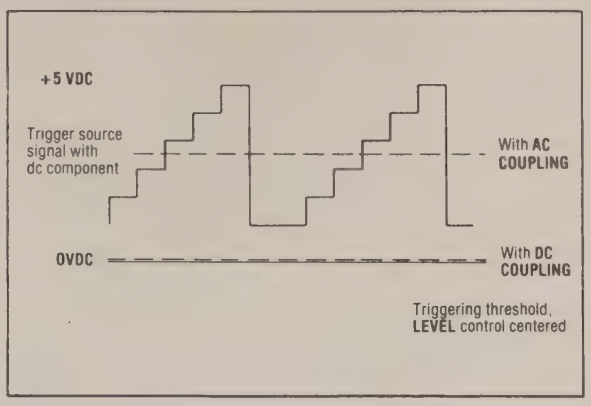

Fig. 8. Effect of COUPLING selection upon LEVEL control setting.

6. FIX-NORM Pushbutton Switch.

When the FIX button is engaged, the LEVEL control is bypassed and the triggering threshold is automatically "fixed" at the center of the sync

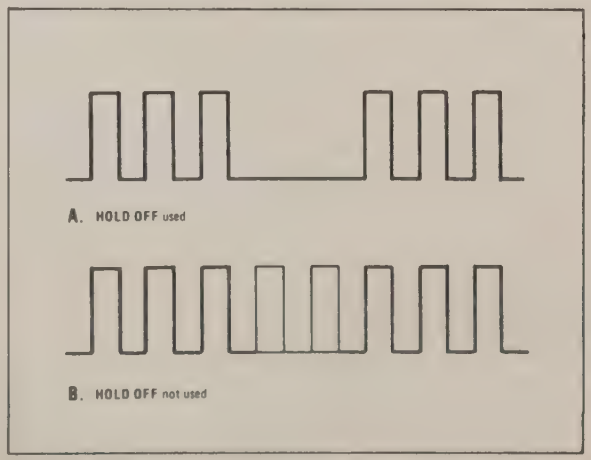

Fig. 9. Use of HOLDOFF control.

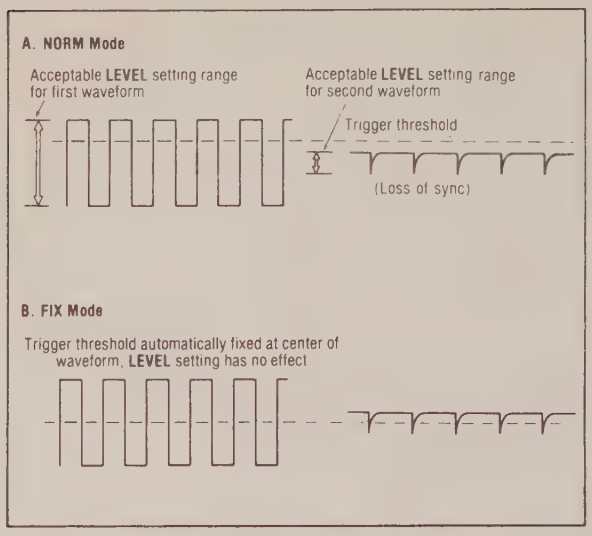
A. NORM Mode
Acceptable LEVEL setting range for first waveform
Acceptable LEVEL setting range for second waveform
Trigger threshold
(Loss of sync)
B. FIX Mode
Trigger threshold automatically fixed at center of waveform, LEVEL setting has no effect

Fig. 10. FIX mode triggering.

trigger waveform. This is often very handy because it eliminates the need to continually readjust the LEVEL control when making waveform measurements at several points which may be of different amplitude and waveshape, or when waveform amplitudes vary throughout a series of tests. Fig. 10 shows an example of how sync may be lost when making consecutive waveform measurements in the NORM mode, but sync is maintained in the FIX mode. The same principle applies when waveform amplitudes vary during testing. The FIX mode maintains sync over the widest possible amplitude variation. Only when the waveform amplitude becomes too low for sweep triggering is sync lost.

For most general waveform observations, the FIX mode is desirable and saves time in set-up. However, the NORM mode must be used if triggering is desired at any point *other* than the center of the waveform, or DC COUPLING of the trigger signal is desired. Even when the NORM mode is required, the FIX mode may expedite initial set-up of the waveform display. You can then switch to the NORM mode and finalize set-up with the LEVEL control.

7. FRAME-LINE Pushbutton Switch.

The FRAME-LINE switch permits selection of vertical or horizontal sync pulses for sweep triggering when viewing composite video waveforms. In the LINE position (button out), horizontal sync pulses are selected as triggers to permit viewing of horizontal lines of video. This is also the position used for viewing all non-video waveforms. In the FRAME position (button engaged), vertical sync pulses are selected as triggers to permit viewing of vertical fields and frames of video.

a. LINE Position.

A typical composite video waveform and the typical control settings for viewing horizontal lines of video are shown in Fig. 11A. The FRAME-LINE switch must be in the LINE position. In this position, the entire video signal is used as the trigger source signal. To use the horizontal sync pulses for triggering, the trigger threshold must be set so that *only the sync pulses portion* of the signal crosses the trigger threshold; *not the video portion.*

As can be seen from Fig. 11, the proper trigger threshold level is near one extreme of the waveform rather than near the center. Therefore, the FIX mode is not suitable, because it automatically fixes the trigger threshold at the center of the waveform.

At most points of measurement, a composite video signal is of the polarity shown in Fig. 11A; that is, the sync pulses are negative and the video is positive. In those cases, use "–" SLOPE and adjust the trigger LEVEL control toward the most negative setting that produces a sweep. If the waveform is taken at a circuit point where the video waveform is inverted, the sync pulses are positive and the video is negative. In those cases, use "+" SLOPE and adjust the triggering LEVEL control toward the most positive setting that produces a sweep.

DC COUPLING is preferred, and must be used when viewing a video signal from a broadcast station. The video portion of a signal from a signal from a broadcast station varies widely, and unpredictably, in average amplitude, depending upon the scene. Only the sync pulse portion of the waveform is constant in amplitude. With DC COUPLING, the amplitude excursions are with respect to the dc component at the point of measurement. The sync pulse amplitude is repetitive with respect to the dc component and stable triggering is possible. AC COUPLING is unsuitable because it centers the waveform

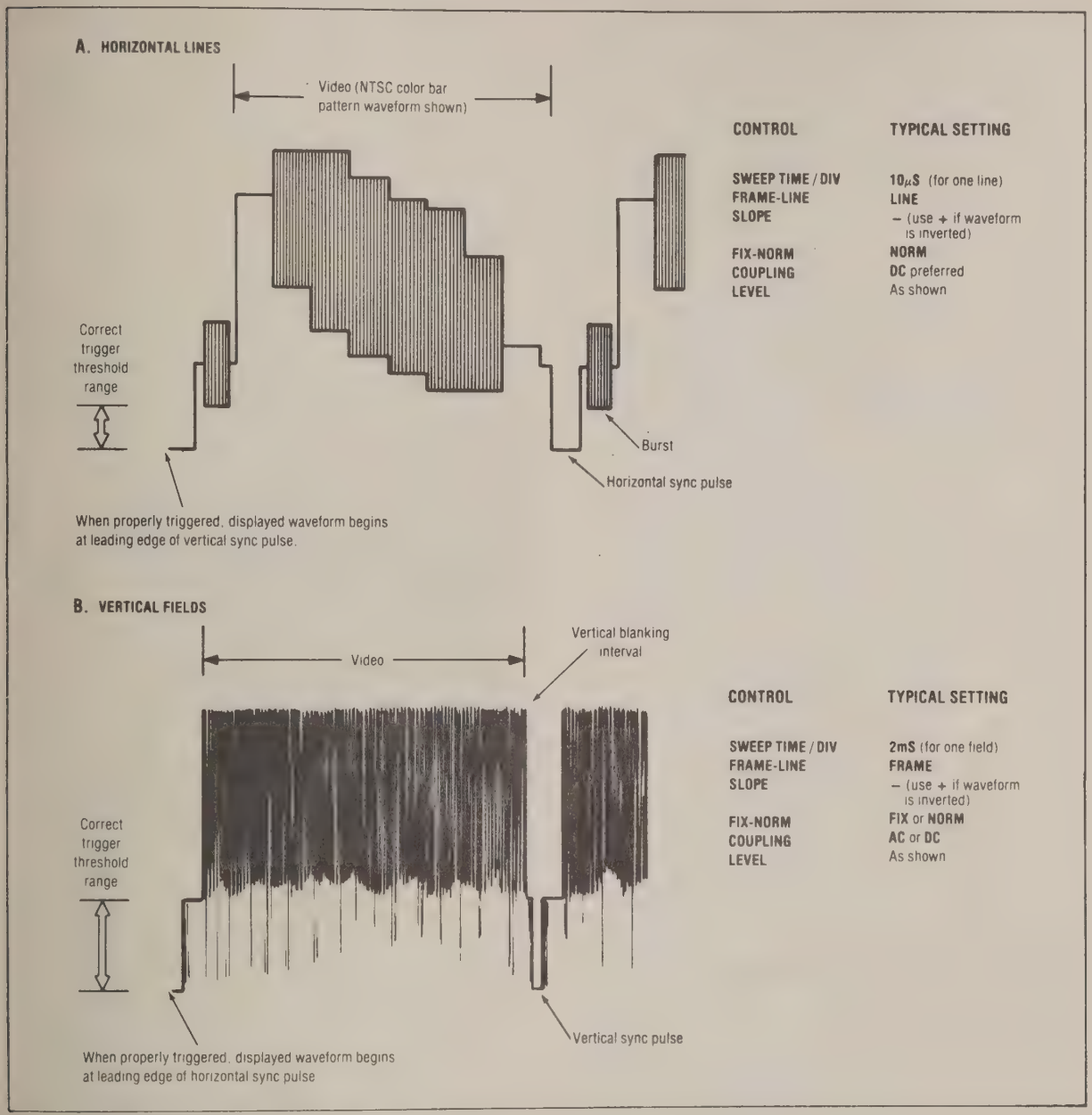

Fig. 11. Observing composite video waveforms.

about the *average* waveform amplitude of the *entire* video signal, and the average amplitude changes constantly when the video portion is included. The triggering point continually shifts and synchronization of the display is impossible. AC COUPLING may be used, if desired, when the video portion of the signal is repetitive, such as when a video pattern generator is used as the signal source. In this case, the average waveform amplitude is approximately constant except when changing from one pattern to another. Of course, even when a repetitive video pattern is used, DC COUPLING is also satisfactory. AC COUPLING is preferable only when the dc component at the point of measurement is large with respect to the video signal.

When viewing horizontal lines of video, triggering on some point other than horizontal sync pulses is possible, if desired. For example, the trigger threshold could be set to permit triggering from the burst signal. If a staircase video pattern is applied, triggering at any step of the pattern could be achieved. In addition, variable holdoff and delayed sweep operation permit close examination of any specific portion of a video signal, even one specific horizontal line out of an entire video frame.

b. FRAME Position.

A typical composite video waveform and the typical control settings for viewing vertical fields and frames of video are shown in Fig. 11B. The FRAME-LINE switch must be in the FRAME position. This routes the trigger source signal through a built-in sync separator circuit which detects and separates the sync pulses from the video signal. The video portion is clipped and only the sync pulses pass. The circuit then filters out the short-duration horizontal sync pulses and passes only the longer-duration vertical sync pulses.

Since none of the video portion of the waveform is coupled, the FIX mode or AC COUPLING is now permissible. However, if the oscilloscope was previously set up for viewing horizontal lines of video at the point of measurement, there is no need to change the triggering LEVEL control setting to obtain proper triggering if you wish to use the NORM mode and DC COUPLING. The SWEEP TIME/DIV must be set to a much slower rate, or course, to view entire fields or frames of video.

8. Triggering Adjustment Procedure.

a. Step 1.

Select the triggering SOURCE, COUPLING, SLOPE, and LEVEL for desired triggering as explained previously. If unsure, start with ALT source, AC coupling, + slope, NORM holdoff, NORM trigger mode, and LINE video.

b. Step 2.

Adjust triggering LEVEL control to obtain a synchronized display without jitter. As a starting point, the control may be rotated to any point that will produce a sweep, which is usually somewhere in the center portion of its range. The trace will disappear if there is inadequate signal to trigger the sweep, such as when measuring dc or extremely low amplitude waveforms. If no sweep can be obtained select AUTO sweep (pull the LEVEL control). If triggering from the center of the waveform is acceptable, press the FIX button.

c. Step 3.

Set SWEEP TIME/DIV switch and VARIABLE control for the desired number of waveforms. These controls may be set for viewing only a portion of a waveform, but the trace becomes progressively dimmer as a smaller portion is displayed. This is because the sweep speed increases but the sweep repetition rate does not change. Readjust the INTENSITY and FOCUS controls if desired.

d. Step 4.

After obtaining the desired number of waveforms, as in step 3, it is often desirable to make a final adjustment of the triggering LEVEL control. The control may be adjusted to start the sweep on any desired portion of the waveform.

e. Step 5.

For a close-up view of a portion of the waveform, pull outward on the ◄►POSITION control. This expands the sweep by a factor of five (5X magnification) and displays only the center portion of the sweep. To view a portion to the left of center, turn the ◄►POSITION control counterclockwise, and to view a portion to the right of center, turn the control clockwise. Push inward on the control to return the sweep to the normal, non-magnified condition. Greater magnification may be obtained by using delayed sweep unless the oscilloscope is already at its fastest sweep rate. Magnification up to 1000 times is practical and is generally limited only by the maximum sweep rate of 0.2 μs/division (40 ns/division with 5X MAG.) Procedures for delayed sweep operation follow.

DELAYED SWEEP OPERATION

The primary purpose of delayed sweep operation is to permit closer examination of a waveform than is otherwise possible. In an oscilloscope without delayed sweep, increasing the sweep speed to view only a portion of a waveform allows only the portion immediate-

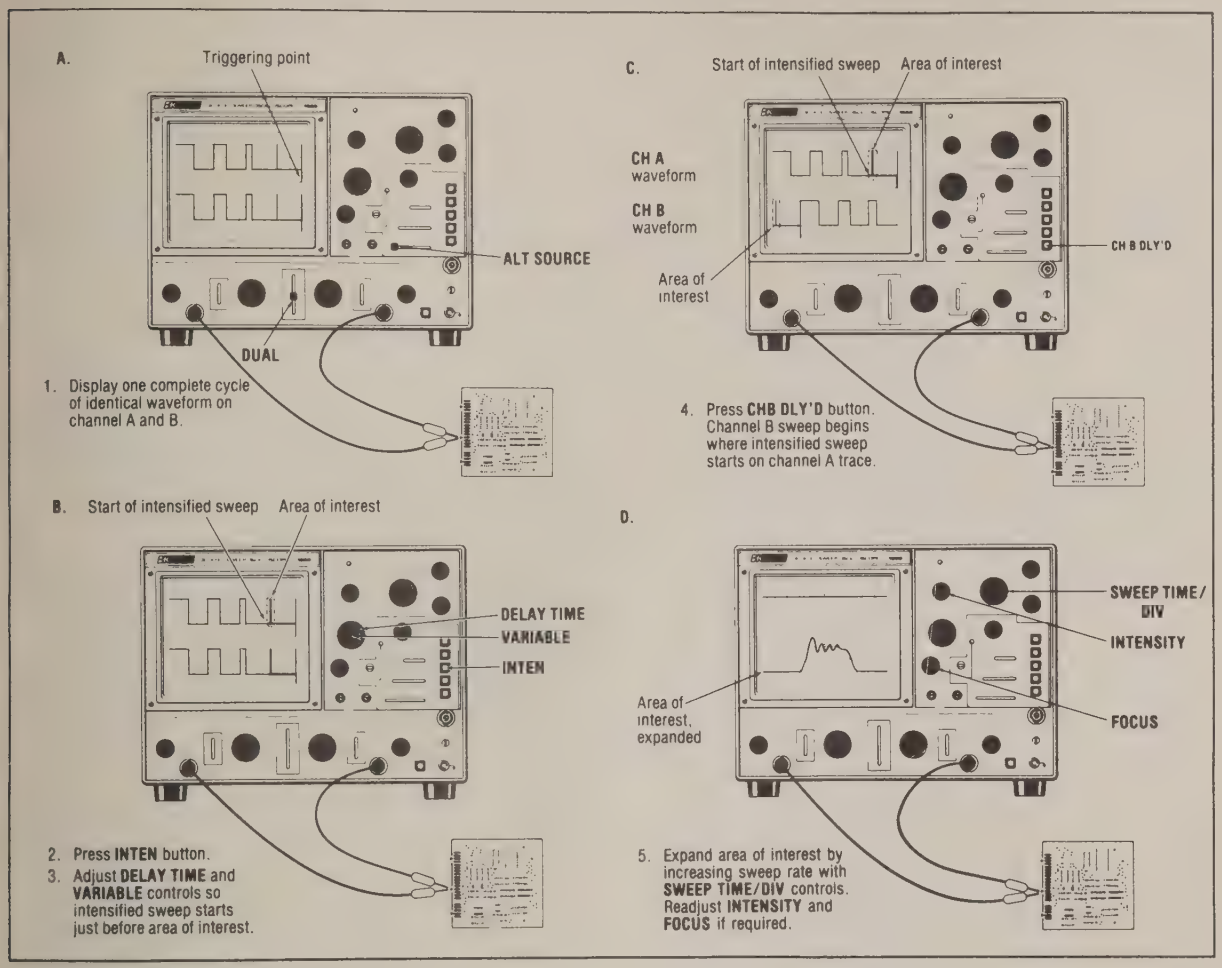
A.
Triggering point
ALT SOURCE
DUAL
1. Display one complete cycle of identical waveform on channel A and B.
B. Start of intensified sweep
Area of interest
DELAY TIME VARIABLE
INTEN
2. Press INTEN button.
3. Adjust DELAY TIME and VARIABLE controls so intensified sweep starts just before area of interest.
C. Start of intensified sweep
Area of interest
CH A waveform
CH B waveform
Area of interest
CH B DLY'D
4. Press CHB DLY'D button. Channel B sweep begins where intensified sweep starts on channel A trace.
D.
SWEEP TIME/DIV
INTENSITY
FOCUS
Area of interest, expanded
5. Expand area of interest by increasing sweep rate with SWEEP TIME/DIV controls. Readjust INTENSITY and FOCUS if required.

Fig. 12. Typical Delayed Sweep Procedure.

ly after the triggering point to be viewed. The delayed sweep feature permits a variable delay to be inserted between the triggering point of the waveform and the start of sweep. Varying the delay period permits any portion of a waveform to be viewed, even when the waveform is greatly expanded by sharply increasing sweep speed. The delay time of this oscilloscope is variable from 1 microsecond to 100 milliseconds in five decade ranges. The low jitter of the variable delay permits sweep rates up to at least 1000 times greater than the repetition rate of the waveform being viewed, if desired, limited by the maximum sweep rate of 0.2 μs/division, or 40 ns/division with 5X MAG.

Fig. 12 illustrates the typical procedure for using the delayed sweep feature. However, there are several possible variations to the procedure which are more fully described below.

For close examination of an entire waveform, increase the sweep speed to achieve the desired degree of waveform expansion, then turn the delay time VARIABLE control counterclockwise to examine portions of the waveform nearer the triggering point, and clockwise to examine portions further from the triggering point. If the VARIABLE control reaches its limit of travel, change ranges with the DELAY TIME switch.

If the delay time exceeds the sweep period, none o. the displayed sweep will be intensified when the INTEN button is engaged. Decrease the DELAY TIME setting until part of the trace is intensified.

In the procedure shown in Fig. 12, the channel A and channel B probes are both connected to the same point of measurement. This is generally preferred because it allows one trace to serve as a point of

reference with intensified sweep while the other trace displays the waveform using delayed sweep, such as shown in Fig. 12C. With this arrangement, either the channel A or channel B display can be selected for delayed sweep presentation by the CH A DLY'D or CH B DLY'D buttons. This technique requires alternate triggering dual-trace operation. However, both probes do not have to monitor the same waveform. If two different waveforms are monitored, you may even wish to select CH A DLY'D and CH B DLY'D simultaneously, which is possible.

It is not necessary to use dual-trace operation to use the delayed sweep feature. In CH A or CH B single-trace operation, pressing the INTEN button gives intensified sweep as shown in Fig. 12B, except only one trace is displayed. This facilitates setting the DELAY TIME and VARIABLE controls to the desired area of interest. Pressing the CH A DLY'D button (CH A single-trace operation) or CH B DLY'D button (CH B single-trace operation) provides the delayed sweep display, as typified by the channel B waveform in Fig. 12C.

RISE TIME MEASUREMENTS

Rise time is defined as the period of time required for a pulse to rise from the 10% level to the 90% level of transition. For convenience in making rise time measurements, the 0%, 10%, 90%, and 100% levels are marked on the graticule scale of the CRT. Merely adjust the amplitude and position controls to display the two states of the pulse at the 0% and 100% marks. Expand the waveform to the fastest calibrated sweep speed that will permit the 0% and 100% points to remain within the horizontal limits of the graticule scale. Measure the time interval between the 10% and 90% levels; this is the pulse rise time.

For direct measurement of rise time, the rise time of the oscilloscope should be at least three times as fast as the pulse being measured. The "observed" rise time is actually the cascaded rise times of the pulse being measured and the oscilloscope's own rise time, which are combined in square law addition as follows:

$$\text{observed rise time} = \sqrt{(\text{pulse rise time})^2 + (\text{scope rise time})^2}$$

The effect of the oscilloscope's rise time is almost negligible when its rise time is at least three times faster than that of the pulse being measured, but increases progressively as the pulse rise time approaches that of the scope. With its 11.7 ns rise time on all except the 2 mV sensitivity range, the Model 1530 Oscilloscope may be used for direct measurement of pulse rise time down to about 35 ns (about 55 ns on the 2 mV sensitivity range). For "observed" rise time below 35 ns, the pulse rise time should be calculated to eliminate the error introduced by the cascaded oscilloscope rise time. Calculate pulse rise time as follows:

$$\text{pulse rise time} = \sqrt{(\text{observed rise time})^2 - (\text{scope rise time})^2}$$

"Observed" rise time measurements below 16 ns are not recommended, because a very small reading error introduces significant error into the calculation.

EXTERNAL HORIZONTAL INPUT (X-Y OPERATION)

For some measurements, an *external* horizontal deflection signal is required. This is also referred to as an X-Y measurement, where the Y input provides vertical deflection and the X input provides horizontal deflection.

In conventional sweep operation, the vertical (Y) axis corresponds to voltage, while the horizontal (X) axis corresponds to time. In X-Y operation, both axes correspond to voltage. The vertical (Y) axis corresponds to the voltage applied to the Channel A input, and the horizontal (X) axis corresponds to the voltage applied to the Channel B input.

X-Y operation permits the oscilloscope to perform many types of measurements not possible with conventional sweep operation. The CRT display becomes an electronic graph of two instantaneous voltages. The display may be a direct comparison of the two voltages such as during phase measurement, frequency measurement with Lissajous waveforms, and vectorscope display of video color bar patterns. However, the X-Y mode can be used to graph almost any dynamic characteristics if a transducer is used to change the characteristic (frequency, temperature, velocity, etc., etc., etc.) into a voltage. For example, the horizontal deflection voltage during frequency response measurements is proportional to frequency; thus X axis corresponds to frequency.

The horizontal input must be 2 mV to 5 V per division of deflection; thus any voltage of 20 mV or greater is sufficient for satisfactory operation. With a 10:1 probe, voltage up to 500 V p-p may be used. To use an external horizontal input, use the following procedure:

1. Set the SWEEP TIME/DIV switch fully clockwise to the CH B position.
2. Use the channel A probe for the vertical input and the channel B probe for the horizontal input.

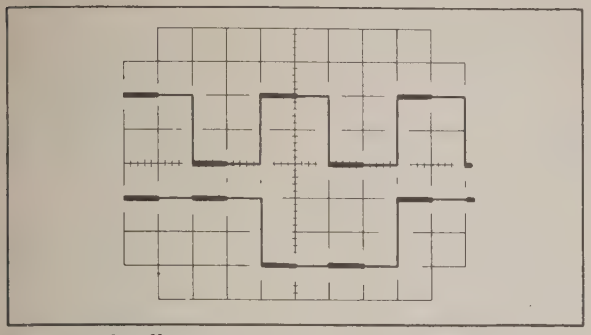

Fig. 13. Oscilloscope trace with Z-axis input.

3. Adjust the amount of horizontal deflection with the CH B VOLTS/DIV and VARIABLE controls.
4. The CH B (vertical) POSITION control now serves as the horizontal position control, and the ◄►POSITION control is disabled.

NOTE

Do not use the PULL 5X MAG control during X-Y operation. Use the CH B VARIABLE and VOLTS/DIV controls to adjust horizontal gain.

5. All sync controls are disconnected and have no effect.

Z-AXIS INPUT

The trace displayed on the screen may be intensity-modulated (Z-axis input) where frequency or time-scale marks are required. A 2-volt peak-to-peak or greater signal applied to the Z-AXIS INPUT jack on the rear of the oscilloscope will provde alternate brightness and blanking of the trace. Positive voltage input increases brightness. See Fig. 13.

SPOT BLANKING

When no signal is applied to the scope in X-Y operation, there is no deflection and the display becomes a stationary spot. This could permanently burn the CRT screen if left at high intensity, such as between set-ups in a series of tests.

In many cases, the spot can be automatically blanked in the absence of signal, or at least reduced in intensity to prevent burning the CRT screen. Conversely, the display is increased in intensity in the presence of signal. This technique uses the intensity modulation feature of the scope, whereby intensity is

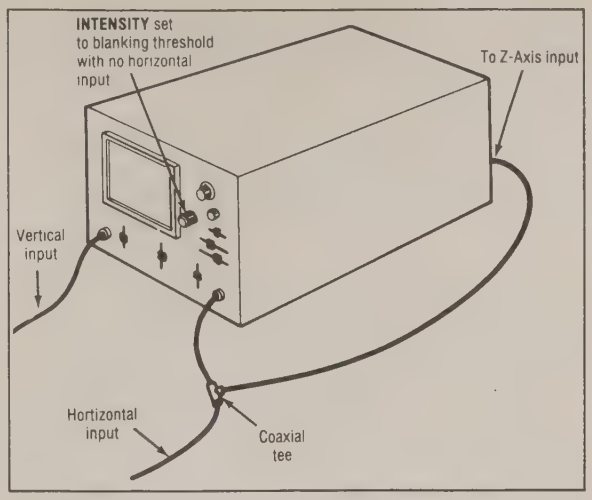

Fig. 14. Connections for spot blanking X-Y operation.

increased when a positive voltage is applied at the Z-AXIS INPUT jack. To use the spot blanking technique, simply tap off the horizontal input signal and apply it to the Z-AXIS INPUT jack too (Fig. 14). With the intensity adjusted just below the blanking level or for a very dim spot *with no signal applied*, any TTL signal or input signal with a positive swing of 2 volts or more should intensify the display to a usable level. Maximum Z-axis input is 50 volts dc + ac peak.

If desired, a spot blanking adapter could be built to provde automatic spot blanking at even lower signal levels, or for signals with a negative voltage swing. Such an adapter would contain a threshold detector (preferably with variable threshold) and a voltage switching transistor. The input to the adapter would be a sample of the horizontal input to the scope, and the output would be a switched voltage to the Z-axis input of the scope. A switched +9 volt output from a transistor battery would work well, or any convenient source of about +5 to +30 volts could be switched.

SINGLE SWEEP

Single sweep operation is valuable for viewing irregular waveforms or instantaneous waveforms such as chattering of contacts when mechanical switches are operated. Such waveforms cannot be viewed clearly when normal repeating sweep is used. This method is also advantageous when photographing such waveforms.

When single sweep operation is enabled, the trace remains blanked until the next trigger signal which ex-

ceeds trigger threshold. Then a single sweep is generated, after which the trace is again blanked. Momentarily setting the SINGLE switch to RESET enables another single sweep. The accompanying READY indicator lights when the single sweep mode is enabled and remains on until the end of the sweep.

The procedure for single sweep operation is as follows:

1. Momentarily set the SINGLE switch to the RESET position. When released, this switch returns to the center (unlabeled) position.
2. The READY indicator lights.
3. The first sync trigger initiates a single sweep.
4. The READY indicator goes off at the end of the sweep.
5. Repeat the procedure for each desired single sweep. Return the SINGLE switch to the NORM position when single sweep operation is completed.

WAVEFORM PHOTOGRAPHS

Waveforms displayed on the CRT may be photographed with an oscilloscope camera. The bezel is slotted to mount a standard oscilloscope camera. The camera should permit double exposure photographs to be taken; that is, the shutter should not be interlocked with the film winder.

1. Adjust oscilloscope controls for a stable, jitter free display of the desired waveform and take a photograph.
2. Next, set the SWEEP TIME/DIV control to about 0.1 mS/division and select automatic sweep with the PULL AUTO position of the trigger LEVEL control.
3. Then hold the SINGLE switch in the RESET position and adjust the INTENSITY control to illuminate the entire CRT screen. This will accentuate the black graticule scale against a light background.
4. Using a double exposure technique, photograph the graticule scale. The result will be a single photograph of the waveform superimposed on the graticule scale.

OPERATOR MAINTENANCE

WARNING

To prevent electric shock, do not perform servicing that requires removal of the covers unless you are qualified to do so. Exposed high voltage, up to 6,000 volts is present when covers are removed. The following procedures do not require removal of the top or bottom cover.

FUSE REPLACEMENT

Fuse F1 is in series with the primary of the power transformer. If this fuse blows, the pilot light will go out and the oscilloscope will not operate. The fuse should not normally open unless a problem has developed in the unit. Try to determine and correct the cause of the blown fuse, then replace only with a fast blow fuse of the proper current rating; 0.6 amp for 120 VAC operation or 0.3 amp for 240 VAC operation. The fuse is located on the rear panel (see Fig. 3).

PERIODIC ADJUSTMENTS

The following operator adjustments only need to be checked and adjusted occasionally. The ASTIG and TRACE ROTATION controls are accessible from the front panel and are adjustable with a flat blade screwdriver. The dc balance adjustments are accessible from the sides of the oscilloscope without removing the bottom case and are adjustable with a very small flat blade screwdriver. The locations of these adjustments are shown in Fig. 3.

Trace Rotation

Strong magnetic fields, present in many locations where an oscilloscope may be used, may cause the trace to be tilted. The degree of tilt may vary as the scope is moved from one location to another. The CRT should be rotated so the trace is parallel with the horizontal lines on the graticule scale.

1. Set oscilloscope controls to produce a horizontal trace with no input signal (PULL AUTO position of triggering LEVEL switch).
2. Use POSITION controls as required to position the trace along a horizontal line of the graticule scale.
3. Adjust TRACE ROTATION so trace is parallel with the reference line on the graticule scale.

Astigmatism

1. Set SWEEP TIME/DIV switch to CH B position and channel A and channel B AC-GND-DC switches to GND position. This will produce a spot on the screen.
2. With INTENSITY control set about mid-range, adjust both the ASTIG and FOCUS controls for the sharpest, roundest spot. Do not readjust ASTIG control after this step.

CAUTION

Never allow a small spot of high brillance to remain stationary on the screen for more than a few seconds. The screen may be permanently burned.

DC Balance

1. Set scope controls for a single horizontal trace on channel A with the channel A AC-GND-DC switch set to GND position.
2. Rotate the Channel A VARIABLE control from maximum clockwise to maximum counterclockwise, while observing the trace.
3. If the trace moves vertically, adjust VR101 (VARI. ATT. BAL.) for minimum or zero movement when performing step. 2.
4. Rotate Channel A VOLTS/DIV switch through the 5 mV, 10 mV, and 20 mV positions while observing the trace.
5. If the trace moves vertically, adjust VR103 (STEP ATT. BAL.) for miimum or zero vertical movement when performing step 4.
6. Repeat the entire procedure for Channel B, adjusting VR106 for VARIABLE balance and VR108 for VOLTS/DIV step balance.

Probe Compensation

Probe compensation adjustment matches the probe to the input of the scope. For best results, compensation of both probes should be adjusted initially, then the same probe always used with channel A and channel B respectively. Probe compensation should be readjusted whenever a probe from a different oscilloscope is used, or the channel A and B probes are interchanged.

1. Connect probes to both INPUT jacks. Connect ground clip of probes of oscilloscope ground terminal and touch tips of both probes to CAL 1 kHz ⎍ 0.5 V p-p terminal.
2. Select single trace operation of channel A, then channel B, for steps 3 and 4.
3. Set oscilloscope controls to display 3 or 4 cycles of CAL square wave at 5 or 6 divisions amplitude.
4. Adjust compensation trimmer on probe for optimum square wave waveshape (minimum overshoot, rounding off, and tilt).

CALIBRATION CHECK

A general check of calibration accuracy may be made by displaying the output of the CAL 1 kHz ⎍ 0.5 V p-p terminal on the screen. This test signal has been factory adjusted to provide a square wave of 0.5 volt peak-to-peak amplitude and 1 millisecond time duration per cycle.

At .1 V/div this should produce five divisions of vertical deflection on channel A or channel B, or five divisions of horizontal deflection in X-Y operation when the VARIABLE controls are set to CAL. The 10 mV/div range may be used to check the 10:1 attenuation of the probe; five divisions of deflection should result.

With a .1 ms/div sweep time and VARIABLE set to CAL, one cycle of the waveform should occupy 10 divisions. At 1 ms/div sweep time, 10 cycles should span the 10 divisions, while 2 cycles should cover the 10 divisions using 5X magnification.

WARRANTY INFORMATION

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the MAINTENANCE section of your **B & K-Precision** instruction manual for adjustments that may be applicable.
2. If the above-mentioned do not correct the problem you are experiencing with your unit, pack it securely (preferably in the original carton or double-packed). Enclose a letter describing the problem and include your name and address. Deliver to, or ship PREPAID (UPS preferred) to the nearest **B & K-Precision** authorized service agency (see list enclosed with unit).

If your list of authorized **B & K-Precision** service agencies has been misplaced, contact your distributor for the name of your nearest service agency, or write to:

Service Department

B & K-Precision Product Group
DYNASCAN CORPORATION
6460 West Cortland Street
Chicago, Illinois 60635

LIMITED ONE-YEAR WARRANTY

DYNASCAN CORPORATION warrants to the original purchaser that its **B & K-Precision** product, and the component parts thereof, will be free from defects in workmanship and materials for a period of one year from the date of purchase.

DYNASCAN will, without charge, repair or replace, at its option, defective product or component parts upon delivery to an authorized **B & K-Precision** service contractor or the factory service department, accompanied by proof of the date purchase in the form of a sales receipt.

To obtain warranty coverage, this product must be registered by completing and mailing the enclosed warranty registration card to DYNASCAN, **B & K-Precision**, 6460 West Cortland Street, Chicago, Illinois 60635 within fifteen (15) days from the date of purchase.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. It is void if the serial number is altered, defaced or removed.

DYNASCAN shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may also have other rights which vary from state to state.

For your convenience we suggest you contact your **B & K-Precision** distributor, who may be authorized to make repairs or can refer you to the nearest service contractor. If warranty service cannot be obtained locally, please send the unit to **B & K-Precision** Service Department, 6460 West Cortland Street, Chicago, Illinois 60635, properly packaged to avoid damage in shipment.

OPTIONAL ACCESSORIES

The following **B & K-Precision** accessories are available to complement your Model 1530 Oscilloscope.

MODEL LC-74 PROTECTIVE COVER

This rugged grained leatherette cover provides convenience and protection when transporting the oscilloscope. A handy pocket provides stowage for probes.

MODEL RM-14 RACK MOUNTING KIT

This kit includes everything needed to mount the oscilloscope in a standard 19" rack, including panel, hardware, and complete instructions.

INSTRUMENT CONNECTING CABLES

The following **B & K-Precision** cables, which may be purchased separately, may be useful for connecting your oscilloscope directly to other equipment:

Model CC-41. 36" RG/58U with a BNC connector on each end.

Model CC-42. 36" RG/58U with BNC connector and UHF connector (PL-259).

Model CC-43. 36" RG/58U with BNC connector and banana plugs.

Model CC-44. 36" RG/58U with BNC connector and coaxial microphone connector.

Model CC-45. 36" RG/58U with BNC connector and type N connector.

MODEL PR-32 RF DEMODULATOR PROBE

This probe permits display and analysis of the modulation envelope of RF signals to 250 MHz (– 6 dB @ 250 MHz). Input impedance is 30 KΩ minimum, shunted by 4.5 pF maximum. Internal shielding protects against stray RF pickup.

NOTICE

This first edition of the instruction manual for the Model 1530 Oscilloscope is a complete operator's manual. We are now preparing complete servicing information, which will be incorporated into the next edition. Among the items included in the servicing information will be theory of operation, performance testing, maintenance, and calibration procedures. If you would like to receive the complete manual as soon as it becomes available at no additional cost, please fill out and return the attached addressed, postage-free postcard.

B+K PRECISION DYNASCAN CORPORATION

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